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(54) **MIRROR ASSEMBLY WITH SINGLE HEATING ELEMENT FOR MULTIPLE SURFACES**

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(51) **Int. Cl.**
G02B 7/182 (2006.01)

(52) **U.S. Cl.** **359/872**

(58) **Field of Classification Search** 359/512, 359/871, 872

See application file for complete search history.

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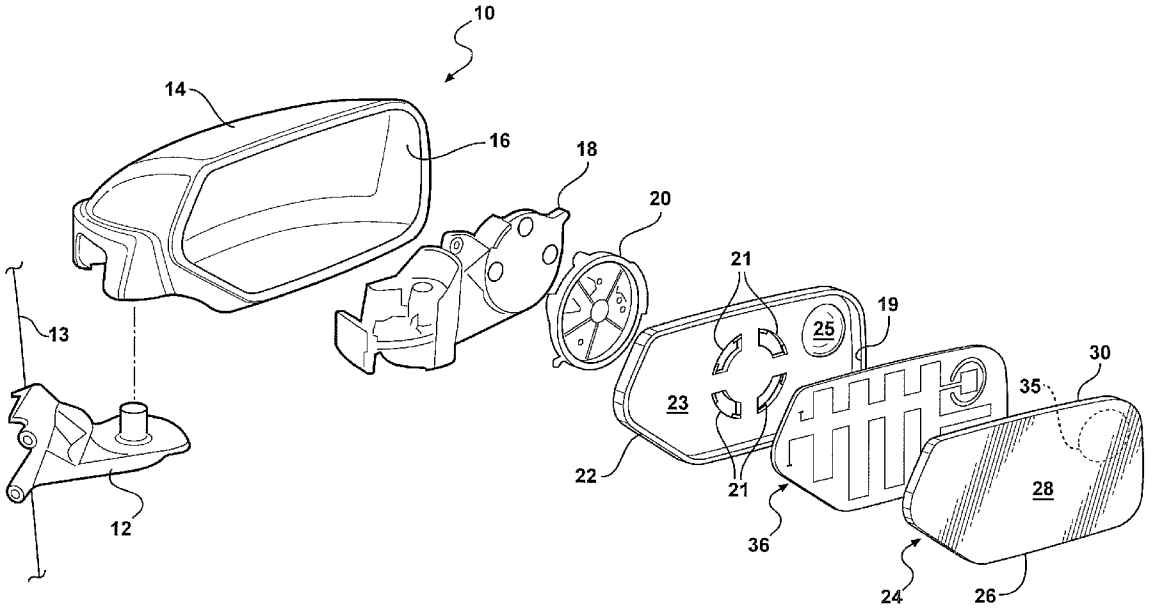
(57) **ABSTRACT**

A rearview mirror assembly for a motor vehicle includes a mirror bracket fixedly secured to the motor vehicle. A mirror case is secured to the mirror bracket. The mirror case defines a primary opening. A backing plate is operatively connected to the mirror case. A mirror is fixedly secured to the backing plate. The mirror defines a substrate having a first surface and a second surface. The second surface defines a primary mirror surface and a spot mirror surface formed within the second surface. The rearview mirror assembly also includes a heating element fixedly secured to the second surface of the mirror for heating the mirror. The heating element includes a primary portion fixedly secured to the primary surface and a secondary portion fixedly secured to the spot mirror surface.

13 Claims, 3 Drawing Sheets



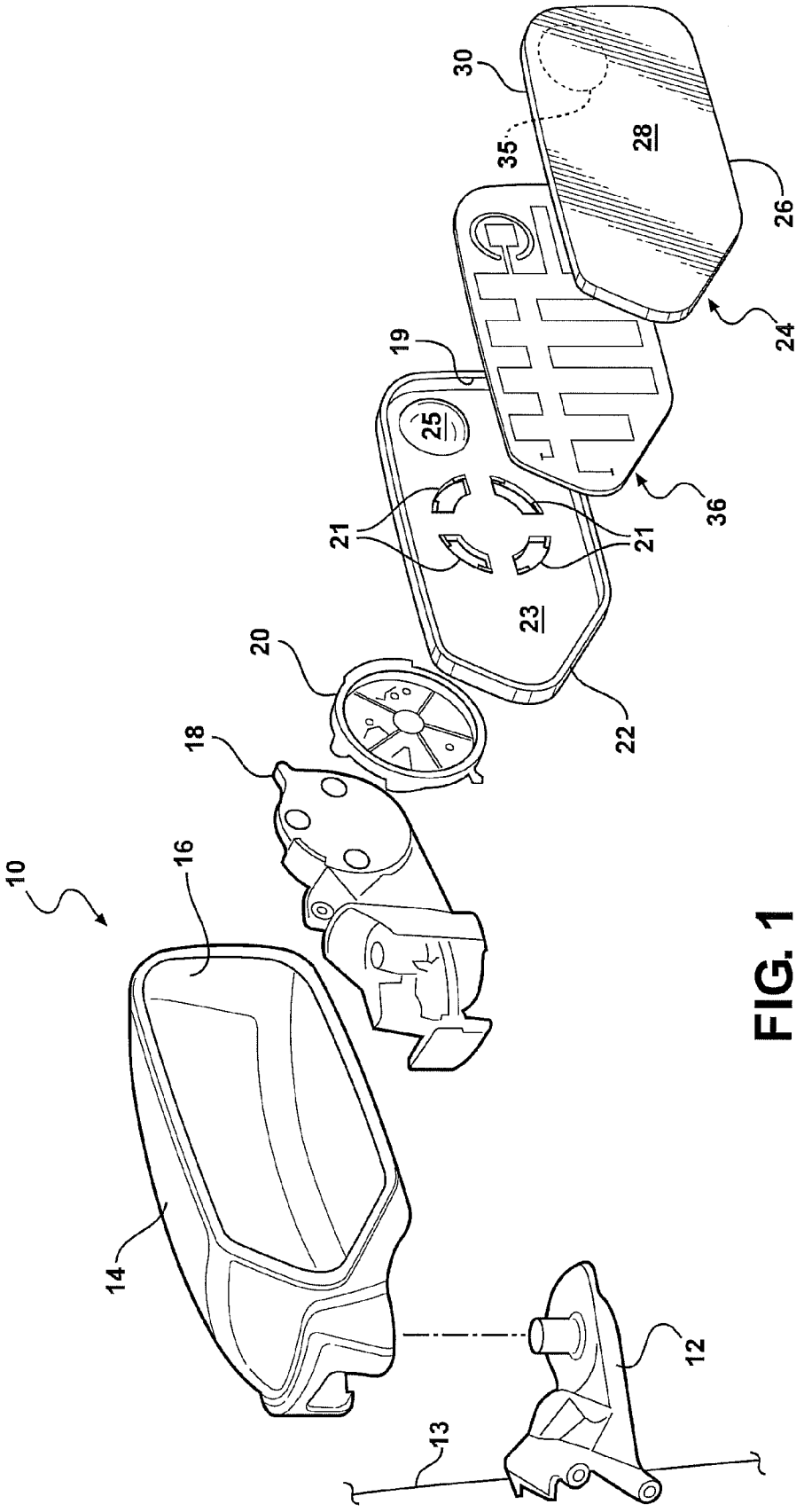


FIG. 1

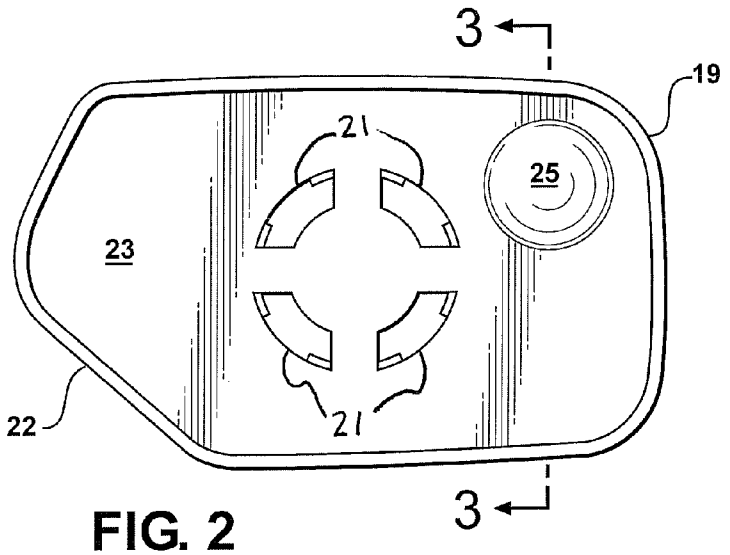


FIG. 2

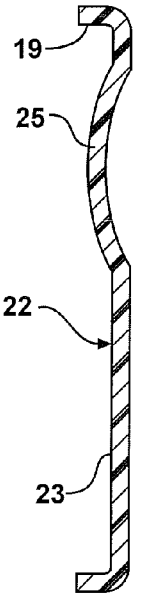


FIG. 3

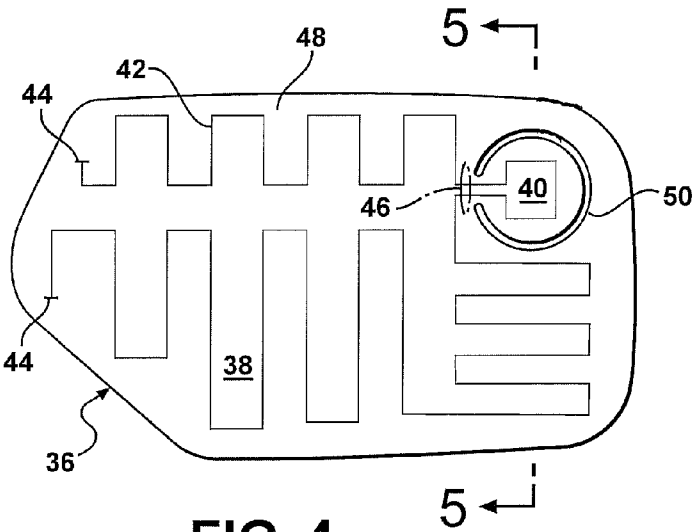


FIG. 4

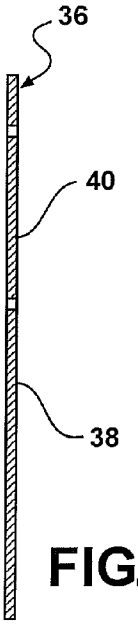


FIG. 5

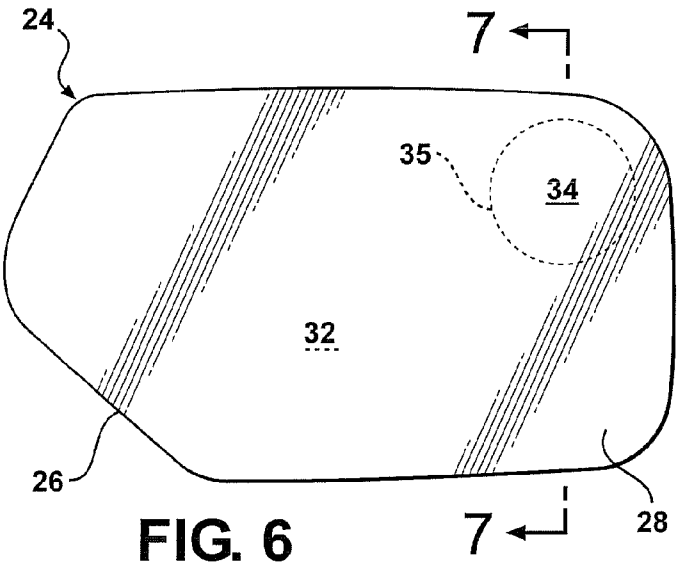


FIG. 6

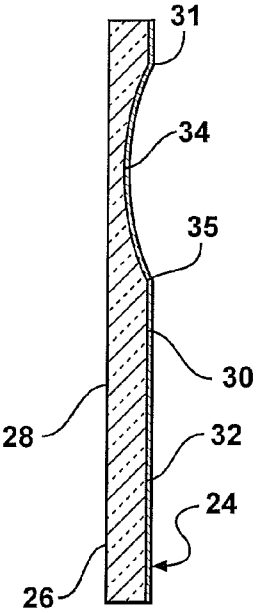


FIG. 7

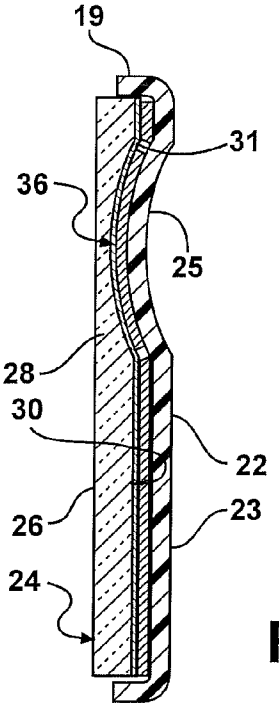


FIG. 8

MIRROR ASSEMBLY WITH SINGLE HEATING ELEMENT FOR MULTIPLE SURFACES

This patent application claims priority to a U.S. provisional patent application having Ser. No. 61/074,620, which is hereby incorporated by reference.

BACKGROUND ART

1. Field of the Invention

The invention generally relates to rearview mirror assemblies for motor vehicles. More particularly, the invention relates to rearview mirror assemblies having a heating element to maintain the usability of the rearview mirror assembly in all weather conditions.

2. Description of the Related Art

Rearview mirror assemblies for motor vehicles are well known. Rearview mirror assemblies having heating elements are also known. The heating elements are difficult to use when the rearview mirror assembly includes a mirror having a substrate with surfaces that extend through multiple planes. More specifically, heating elements are difficult to use with mirrors that have a substrate that define more than one mirror. Such configurations include a rearview mirror assembly having a primary mirror and a spot mirror. A conventional heating element will not conform to the depression in the area of the spot mirror while it is adhered to the area of the primary mirror.

Some mirror assemblies incorporate a plurality of heating elements, one for every surface associated with a reflective surface. This solution is deficient in that it requires a great deal of manufacturing technique to maintain an electrical connection across all of the surfaces while assembling the mirror assembly.

SUMMARY OF THE INVENTION

A rearview mirror assembly for a motor vehicle includes a mirror bracket fixedly secured to the motor vehicle. A mirror case is secured to the mirror bracket. The mirror case defines a primary opening. A backing plate is operatively connected to the mirror case. A mirror is fixedly secured to the backing plate. The mirror defines a substrate having a first surface and a second surface. The second surface defines a primary mirror surface and a spot mirror surface formed within the second surface. The rearview mirror assembly also includes a heating element fixedly secured to the second surface of the mirror for heating the mirror. The heating element includes a primary portion fixedly secured to the primary surface and a secondary portion fixedly secured to the spot mirror surface.

BRIEF DESCRIPTION OF THE DRAWINGS

Advantages of the invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. **1** is an exploded perspective view of one embodiment of the invention;

FIG. **2** is a rear view of a backing plate;

FIG. **3** is a cross-sectional side view taken along lines **3-3** of FIG. **2**;

FIG. **4** is a rear view of a heating element;

FIG. **5** is a cross-sectional side view taken along lines **5-5** of FIG. **4**;

FIG. **6** is a rear view of a mirror substrate;

FIG. **7** is a cross-sectional view taken along lines **7-7** of FIG. **6**; and

FIG. **8** is a cross-sectional view of a backing plate, a heating element, and a mirror substrate according to one embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the Figures, a rearview mirror assembly is generally indicated at **10**. The rearview mirror assembly includes a mirror bracket **12** and a minor case **14**. The mirror bracket **12** is fixedly securable to a motor vehicle **13** allowing the operator of the motor vehicle **13** to view areas rearward of the motor vehicle **13**.

The mirror case **14** defines a mirror opening **16**. It should be appreciated by those skilled in the art that while none are shown in the Figures, openings in the mirror case **14** other than the mirror opening **16** may exist without affecting the invention disclosed herein.

A support structure **18** is fixedly secured within the mirror case **14**. The support structure **18** may also be pivotally secured to the bracket **12** allowing the mirror case **14** to pivot with respect to the bracket **12** and the motor vehicle **13**. The support structure **18** provides a base upon which the mechanisms, discussed in greater detail subsequently, may operate.

In the embodiment shown in the Figures, a motor mechanism **20** is movably secured to the support structure **18** and has at least a portion thereof that moves with respect to the support structure **18** and the mirror case **14**. A motor mechanism **20** may not be employed in some models of the mirror assembly **10**. In such instances, a manual cable system may be used. In other instances, even a cable system may be absent resulting in positioning performed by directly pushing a mirror surface, discussed subsequently, whereby the mirror surface pivots with respect to the mirror case **14** and maintains a particular position due to a friction fit mechanism (not shown) provided in place of the motor mechanism **20**.

A backing plate **22** is fixedly secured to the motor mechanism **20** and is therefore operatively connected to the mirror case **14**. In the embodiment shown, the orientation of the backing plate **22** is dependent on the operation of the motor mechanism **20** and will move based thereon. The backing plate **22** may include a rim **19** which may, in certain designs, be used to secure a mirror to the backing plate **22**. Apertures **21** extend through the backing plate **22** and allow the backing plate **22** to be secured to the motor mechanism via a snap fit

The backing plate **22** also includes a primary backing section **23** and a secondary backing section **25**. The primary backing section **23** is larger in area than the secondary backing section **25**. While the primary backing section **23** is flat in the embodiment shown (i.e., the radius of curvature is infinite), the primary backing section **23** may have curvature depending on whether the mirror assembly **10** is designed to be mounted to the driver side or the passenger side. The absence or presence of curvature in the primary backing section **23** is also dependent on the laws of a particular country and whether such curvature is permitted, mandated, or prohibited. Regardless, the secondary backing section **25** defines one or more radius (radii) of curvature that is (are) much smaller than that of the primary backing section **23**.

A mirror **24** is fixedly secured to the backing plate **22** such that there is no lost motion between the mirror **24** and the backing plate **22**. The mirror **24** defines a clear substrate **26**, e.g., glass, polycarbonate or acrylic, having a first surface **28** and a second surface **30**. The second surface **30** defines a primary mirror surface **32** and a spot mirror surface **34**. The

spot mirror surface **34** defines a periphery **35**. In this embodiment, the second surface **30** has a reflective coating **31** (best seen in FIGS. **7** and **8**) so that the driver of the motor vehicle **13** to which the rearview mirror assembly **10** is attached will look through the first surface **28** and see a reflection created by the second surface **30**. In one embodiment, the substrate **26** is fabricated from glass. Other materials may be contemplated which have physical properties similar to glass.

As with the backing plate **22**, the primary mirror surface **32** is either flat or slightly curved, depending on the side of the motor vehicle **13** to which it is attached and/or the territory in which the mirror assembly **10** is to be utilized. Likewise, the spot mirror surface **34** has more curvature (smaller radius (radii) of curvature(s)) allowing the operator of the motor vehicle **13** a greater field of view than is obtainable by viewing only the primary mirror surface **32**.

The contours of the primary mirror surface **32** and the spot mirror surface **34** complement the primary backing section **23** and the secondary backing section **25** of the backing plate **22**, respectively. Said another way, there are no variations in the distances between any portion of the backing plate **22** and its respective portion of the second surface **30** of the mirror **24**.

A heating element, generally shown at **36**, is fixedly secured to the second surface **30** of the mirror **24**. The heating element **36** heats the mirror **24** to remove any precipitation, in the form of gas, liquid or solid, from the first surface **28** of the mirror **24**. The heating element **36** does this by heating the substrate **26** and hence the precipitation to a temperature that allows the precipitation to evaporate.

Referring to FIG. **4**, the heating element **36** includes a primary portion **38** and a secondary portion **40**. The primary portion **38** is fixedly secured to the primary mirror surface **32**, whereas the secondary portion **40** is fixedly secured to the spot mirror surface **34**. A cut out **50**, described in greater detail subsequently, separates the secondary portion **40** from a portion of the primary portion **38**. The cut out **50** may define a partial periphery that may represent the periphery **35** of the spot mirror surface **34**.

In one embodiment of the invention, the heating element **36** includes a single conductor **42** that winds its way between the primary **38** and secondary **40** portions. The single conductor **42** defines a serpentine path. The single conductor **42** ends at two terminals **44** which are electrically connected to power using the wire harness (not shown) of the rearview mirror assembly **10** as is known in the art. When an electrical current passes through the conductor **42**, the conductor **42** radiates thermal energy, which the substrate **26** then distributes over its entire first surface **28**.

The heating element **36** includes a neck **46** that connects the primary **38** and secondary **40** portions. The neck **46** is defined as the portion disposed between the ends of the cut out **50**. The heating element **36** also includes a carrier **48** to which the single conductor **42** and the terminals **44** are secured. The carrier **48** is used to facilitate the ease and consistency of applying the single conductor **42** to the second surface **30** of the mirror **24**. The carrier **48** defines the cut out **50** that, but for area disposed adjacent the neck **46**, circumscribes the secondary portion **40** of the heating element **36**. The width of the cut out **50** may vary depending on the shape of the spot mirror surface **34** or its periphery **35**. In one embodiment, the carrier **48** has adhesive disposed on both sides that provides the means for securing it to the substrate **26** and to the backing plate **22**.

In an alternative embodiment, the heating element may be a layer of conductive material deposited on the carrier **48**. The layer of conductive material may be deposited onto the carrier **48** or it may be a foil layer placed between the backing layer and the substrate **26**. It should be appreciated by those skilled in the art that the heating element **36** may be any type of material capable of occupying a thin space and conduct thermal energy when an electric current is drawn thereacross.

In operation, the single heating element **36** is applied to the second surface **30** of the mirror **24**. Because the cut out **50** exists in the heating element **36**, the secondary portion **40** of the heating element **36** can conform to the spot mirror surface **34** of the mirror **24** without unduly deforming the heating element **36**. The heating element **36** maybe used for both the primary mirror surface **32** and the spot mirror surface **34** of the second surface **30**. In other words, the primary portion **38** and the secondary portion **40** of the heating element **36**, which incorporates the single conductor **42** extending through both, is used to provide an adequate means for heating the second surface **30**, including both the primary surface **32** and the spot mirror surface **34** in a uniform fashion. The cut out **50** allows the secondary portion **40** to be secured to the spot mirror surface **34**, which extends through a curved plane while allowing the primary portion **38** to be secured to the primary mirror surface **32**, which extends through a plane of lesser curvature or no curvature.

The invention has been described in an illustrative manner. It is to be understood that the terminology, which has been used, is intended to be in the nature of words of description rather than of limitation.

Many modifications and variations of the invention are possible in light of the above teachings. Therefore, within the scope of the appended claims, the invention may be practiced other than as specifically described.

We claim:

1. A rearview mirror assembly for a motor vehicle, said rearview mirror assembly comprising:

a mirror bracket fixedly secured to the motor vehicle;

a mirror case secured to said mirror bracket, said mirror case defining a mirror opening;

a backing plate operatively connected to said mirror case;

a mirror fixedly secured to said backing plate, said mirror defining a substrate having a first surface and a second surface, said second surface defining a primary mirror surface and a spot mirror surface formed within said second surface; and

a heating element fixedly secured to said second surface of said mirror between said second surface and said backing plate, said heating element heats said mirror, said heating element including a primary portion fixedly secured to said primary mirror surface and a secondary portion fixedly secured to said spot mirror surface.

2. A rearview mirror assembly as set forth in claim **1** wherein said heating element includes a single conductor extending through said primary portion and said secondary portion.

3. A rearview mirror assembly as set forth in claim **2** wherein said heating element includes a neck connecting said primary and secondary portions.

4. A rearview mirror assembly as set forth in claim **3** wherein said primary portion extends through a primary plane and said secondary portion extends through a secondary plane different than said primary plane.

5. A rearview mirror assembly as set forth in claim **4** wherein said heating element includes a carrier defining a cut out.

6. A rearview mirror assembly as set forth in claim **5** wherein said cut out is disposed adjacent said neck of said heating element.

7. A rearview mirror assembly as set forth in claim **6** wherein said backing plate includes a primary backing section and a secondary backing section.

8. A rearview mirror assembly as set forth in claim **7** wherein said backing plate complements said second surface of said substrate such that said primary backing section is disposed adjacent said spot mirror surface and said secondary baking section is disposed adjacent said primary mirror surface.

9. A rearview mirror assembly as set forth in claim **8** wherein said heating element defines a serpentine path through said carrier.

10. A rearview mirror assembly as set forth in claim **9** wherein said serpentine path extends through a surface area correlating to said primary mirror surface and said spot mirror surface.

11. A rearview mirror assembly as set forth in claim **10** wherein said serpentine path is a single path.

12. A rearview mirror assembly as set forth in claim **11** wherein said heating element is a metallic coating applied to said carrier.

13. A rearview mirror assembly as set forth in claim **7** wherein said heating element is a metallic coating applied to said carrier.

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